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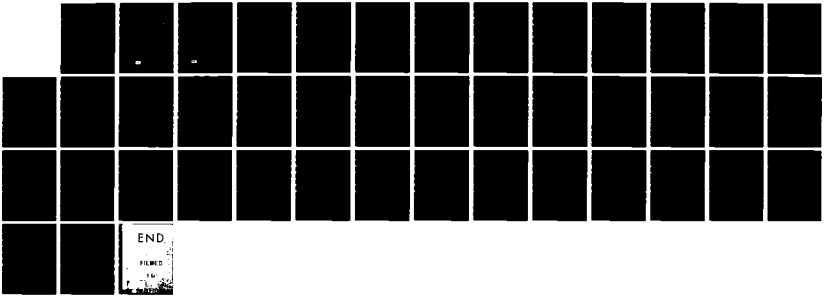

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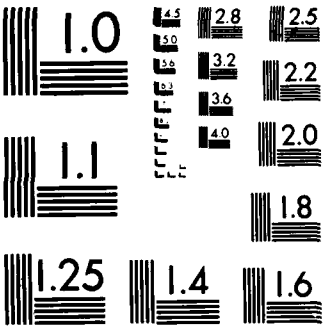

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A COMPARISON OF THE PROPHET AND ACOL FORCE PROJECTION MODELS

Matthew S. Goldberg
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ABSTRACT

We compared the projections of the PROPHET and ACOL models to historical experience over the period FY 78 - FY 80. The PROPHET model tracks the distribution of the force by years of remaining obligated service, but does not allow reenlistment rates to vary in response to changes in compensation. Conversely, the ACOL model does allow reenlistment rates to vary in response to changes in compensation, but does not track the distribution of the force by years of remaining obligated service. We found that the ACOL projections are more accurate than the PROPHET projections. Evidently, adjusting reenlistment rates in response to pay changes is more important than tracking the force by years of remaining obligated service.

We also ran projections of the two models sequentially, so that the PROPHET model projections of expired obligations were used as an input to the ACOL model. The results of this procedure were superior to those obtained using either model separately. However, we still had a forecast error of 3 to 4 percentage points. To reduce this error, we made allowance for the effect of first-term reenlistment bonuses on subsequent second-term reenlistment rates. This enabled us to reduce the forecast error to about 2 percentage points.

We were able to further reduce the forecast error to almost zero by using information on civilian unemployment during the projection period, FY 78-FY 80. However, this information is only available through hindsight, and would not have been available had the projections actually been made during the base year, FY 77. Therefore, the strongest conclusion possible is that the ACOL projections are accurate to within 2 percentage points, with most of the remaining forecast error being attributable to variation in civilian unemployment over the projection period.

A COMPARISON OF THE PROPHET AND ACOL FORCE PROJECTION MODELS

INTRODUCTION

The Center for Naval Analyses has developed two models for projecting enlisted force levels: the PROPHET model (references 1-3), and the more widely-known ACOL model (references 4-5). This paper compares the career force projections of these models to actual historical experience over the period FY 78-FY 80. We also refine the ACOL model to allow for the effect of first-term reenlistment bonuses on subsequent second-term reenlistment rates.

DESCRIPTION OF THE MODELS

The PROPHET model uses retention behavior over a base year to estimate reenlistment rates by LOS. These reenlistment rates are then applied to age the enlisted force over all years in the projection period. The reenlistment rates are assumed fixed, and are not allowed to vary in response to changes in compensation over the projection period. The PROPHET model also tracks the distribution of the force by years of remaining obligated service. The reenlistment rates are applied only to those individuals whose obligations expire within each respective year of the projection period.

The ACOL model allows reenlistment rates to vary in response to changes in compensation. This is accomplished by means of a logistic supply function that expresses reenlistment rates by LOS in terms of relative military compensation. The ACOL models does not track the distribution of the force by years of remaining obligated service. Instead, the user must supply his own estimate of the fraction of individuals whose obligations will expire within each year of the projection period.

Both PROPHET and ACOL provide end strength projections only for LOS cells 2-30. The end strength at LOS 1 is determined as a residual, by subtracting the end strength in LOS cells 2-30 from a total end strength goal.

RETENTION BEHAVIOR, FY 78-FY 80

Table 1 presents the end strength by LOS for FY 78-FY 80. We also present total end strength and career force, which is derived by subtracting the end strength in LOS cells 1-4 from total end strength.

Table 2 presents reenlistment rates by LOS for FY 78-FY 80. Table 3 presents the fraction of individuals whose obligations expired, by LOS, for FY 78-FY 80.

TABLE 1

HISTORICAL ENDSTRENGTH

LOS	FY 78	FY 79	FY 80
1	73,728	72,159	78,322
2	78,029	65,719	65,902
3	66,102	70,379	60,622
4	53,783	55,447	60,515
5	24,416	28,593	28,115
6	20,362	20,027	22,496
7	17,447	16,051	15,670
8	15,330	15,520	14,593
9	11,721	12,713	13,193
10	10,814	10,225	11,329
11	9,086	9,538	9,128
12	6,954	8,579	8,991
13	6,854	6,632	8,113
14	8,222	6,622	6,371
15	7,214	7,913	6,388
16	6,978	6,982	7,711
17	8,228	6,752	6,796
18	8,989	8,073	6,628
19	9,360	8,777	7,927
20	6,359	7,768	7,240
21	3,867	3,558	4,002
22	2,208	2,423	2,386
23	1,796	1,504	1,656
24	1,482	1,265	1,089
25	832	1,148	941
26	472	673	915
27	510	343	492
28	351	402	260
29	148	307	340
30+	331	235	322
Total force	461,973	456,327	458,453
Career force	190,331	192,623	193,092

TABLE 2

HISTORICAL REENLISTMENT RATES

LOS	FY 78	FY 79	FY 80
1	.4681	.4779	.3816
2	.4013	.4432	.3790
3	.1898	.1960	.2553
4	.2367	.2244	.2426
5	.3720	.3289	.2961
6	.2830	.3077	.3390
7	.4519	.4585	.5051
8	.4799	.4599	.5094
9	.5678	.5234	.5704
10	.6730	.6255	.6592
11	.7477	.7214	.7411
12	.7716	.7852	.8002
13	.8432	.8467	.8460
14	.8913	.8825	.8863
15	.9302	.9198	.9333
16	.9386	.9345	.9459
17	.9619	.9593	.9497
18	.9304	.9455	.9598
19	.9306	.9504	.9534
20	.3306	.3314	.3041
21	.4438	.3832	.4275
22	.4446	.3795	.4709
23	.5085	.4738	.5528
24	.6481	.5527	.5526
25	.7200	.6196	.6619
26	.5276	.5474	.5508
27	.5500	.5446	.5111
28	.7895	.6452	.6582
29	.5600	.3846	.2954

TABLE 3

HISTORICAL FRACTIONS OF EXPIRED OBLIGATIONS

LOS	FY 78	FY 79	FY 80
1	.0011	.0015	.0018
2	.0081	.0059	.0056
3	.1082	.1324	.[illegible]26
4	.6200	.6180	.[illegible]9
5	.1461	.2432	.[illegible]16
6	.3029	.2985	.[illegible]5
7	.1388	.1784	.[illegible]8
8	.3191	.3056	.[illegible]
9	.2814	.2569	.[illegible]
10	.2960	.2877	.3056
11	.1648	.1580	.1794
12	.1942	.1861	.2322
13	.1300	.1551	.1831
14	.1490	.1677	.2125
15	.1479	.1781	.2124
16	.1720	.1970	.2279
17	.1377	.1343	.1916
18	.1052	.1124	.1569
19	.1666	.1769	.2255
20	.3060	.3288	.3919
21	.2803	.3145	.3373
22	.2331	.2518	.3198
23	.2330	.2339	.2766
24	.2042	.2368	.2403
25	.2140	.2212	.2447
26	.2315	.2013	.2778
27	.2620	.2196	.2623
28	.2317	.1766	.1965
29	.2119	.1757	.2866

Our PROPHET and ACOL projections both employ FY 77 as the base year. The FY 77 end strengths were used as the begin strengths for the first projection year in both cases. In addition, FY 77 data were used to estimate the reenlistment rates employed by PROPHET. We used the actual total endstrength in each of FY 78-FY 80 as the total end strength goal for both models.

The ACOL model requires as inputs the average first- and second-term bonus multiples by year, and the annual percentage increase in relative military pay. We computed the average bonus multiple as a weighted average of the bonus multiples in each rating, where the number of eligibles in the rating serves as the weight. We computed the percentage increase in relative military pay as the difference between the percentage increase in RMC and the percentage increase in wages in the civilian manufacturing sector (reference 6). These inputs are shown in table 4.

PROJECTIONS OF THE PROPHET MODEL

Table 5 contains the PROPHET projections of the fraction of individuals whose obligations expire. These predictions are quite close to the actual values displayed in table 3 above. The ability of PROPHET to track this distribution is the major advantage of the model.

TABLE 4

INPUT INTO ACOL MODEL

	FY 78	FY 79	FY 80
First-term bonus	1.74	1.22	1.57
Second-term bonus	1.08	0.90	2.06
Percent change RMC	6.2	5.5	7.0
Percent change manufacturing wages	8.7	8.2	7.9

TABLE 5

PROPHET PROJECTIONS OF EXPIRED OBLIGATIONS

LOS	FY 78	FY 79	FY 80
1	.0011	.0009	.0008
2	.0044	.0045	.0041
3	.1221	.1195	.1394
4	.6083	.6555	.6970
5	.2219	.2600	.2242
6	.3156	.3015	.3018
7	.1708	.1627	.1401
8	.3158	.3078	.3274
9	.2497	.2389	.2569
10	.2723	.2673	.2868
11	.1394	.1436	.1370
12	.1771	.1979	.1934
13	.1357	.1476	.1503
14	.1518	.1711	.1803
15	.1675	.1785	.1898
16	.1819	.1971	.2143
17	.1352	.1623	.1549
18	.1144	.1422	.1395
19	.1879	.2241	.2069
20	.3480	.3896	.3737
21	.3326	.3705	.3581
22	.2583	.3064	.2963
23	.2543	.2810	.2610
24	.2299	.2323	.2307
25	.2379	.2482	.2386
26	.2514	.2412	.2588
27	.2661	.3038	.3000
28	.2017	.1842	.1939
29	.2041	.2373	.2572

Table 6 contains the PROPHET projections of the endstrength profile. Comparing table 6 to table 1, we see that PROPHET overpredicted the career force in each of the projection years. Recall from table 4 that relative military pay declined over the period FY 78-FY 80. However, PROPHET does not allow reenlistment rates to respond to pay changes. Therefore, the PROPHET projections were overly optimistic during a period of declining relative military pay.

PROJECTIONS OF THE ACOL MODEL

As noted earlier, the ACOL model requires as input an estimate of the fraction of individuals whose obligations expire. One possibility would be to use the actual fractions observed during FY 78 - FY 80. However, this would give the model an unfair advantage, since these fractions are available now through hindsight but would not have been available had the projections actually been made during FY 77.

Another alternative, which provides a fair test of the model, is to apply the fractions observed during the base year, FY 77, throughout the projection period.

A final alternative, which should yield superior results, is to use the projected fractions from the PROPHET model as an input to the ACOL model. That is, we run the two models sequentially.

TABLE 6

PROPHET PROJECTIONS OF ENDSTRENGTH

LOS	FY 78	FY 79	FY 80
1	64,878	78,645	87,982
2	76,830	53,917	65,303
3	66,397	65,701	46,167
4	54,725	54,341	53,768
5	27,106	31,044	29,309
6	20,521	22.824	25,515
7	18,271	16,046	18,022
8	15,727	16,482	14,537
9	12,689	13,819	14,517
10	11,331	11,540	12,603
11	9,347	10,371	10,568
12	7,075	8,978	9,944
13	7,009	6,774	8,572
14	8,278	6,775	6,539
15	7,296	8,045	6,574
16	7,064	7,114	7,839
17	8,286	6,906	6,952
18	9,020	8,109	6,751
19	9,552	8,724	7,828
20	7,382	7,284	6,550
21	4,267	3,779	3,627
22	2,443	2,706	2,356
23	2,045	1,694	1,843
24	1,614	1,438	1,179
25	891	1,229	1,094
26	533	742	1,024
27	590	418	584
28	357	418	294
29	147	295	346
30	302	169	267
Total force	461,973	456,327	458,453
Career force	199,037	203,673	205,202

This procedure does not utilize any information that would have been unavailable had the projections actually been made during FY 77. Moreover, it combines the PROPHET model's ability to track expired obligations with the ACOL model's ability to adjust reenlistment rates to pay changes.

COMPARISONS OF PROPHET AND ACOL PROJECTIONS

Table 7 contains the ACOL model's projections of reenlistment rates. Table 8 contains the ACOL force level projections using FY 77 expired obligations. Table 9 contains the ACOL force level projections using the PROPHET projections of expired obligations. Table 10 summarizes the various projections obtained using PROPHET, ACOL, and the two models sequentially.

It is apparent from table 10 that the PROPHET model is a less effective forecasting tool. This is because PROPHET does not adjust reenlistment rates in response to pay changes. The ACOL model outperforms the PROPHET model, even when the base year fraction of expired obligations is used throughout the projection period. Evidently, adjusting reenlistment rates to pay changes is more important than tracking the distribution of expired obligations. However, the best results are obtained when PROPHET and ACOL are used sequentially. The percentage deviations between these predictions and the actual career force levels are 2.7 percent in FY 78, 2.8 percent in FY 79, and 4.0 percent in FY 80.

TABLE 7

ACOL PROJECTIONS OF REENLISTMENT RATES

LOS	FY 78	FY 79	FY 80
1	.4049	.3934	.3896
2	.1772	.1693	.1667
3	.2024	.1815	.1849
4	.2359	.2124	.2162
5	.4087	.3763	.3786
6	.3106	.2812	.2833
7	.5197	.4931	.5206
8	.5755	.5482	.5768
9	.6152	.5875	.6180
10	.7006	.6735	.6969
11	.7592	.7396	.7328
12	.8434	.8283	.8230
13	.8422	.8260	.8203
14	.8971	.8848	.8805
15	.9297	.9202	.9167
16	.9384	.9288	.9253
17	.9541	.9454	.9421
18	.9526	.9405	.9359
19	.9865	.9798	.9770
20	.3650	.3427	.3355
21	.4115	.3878	.3800
22	.4362	.4087	.3997
23	.5125	.4873	.4789
24	.5767	.5503	.5414
25	.7191	.6950	.6868
26	.7102	.6779	.6667
27	.5305	.5117	.5054
28	.6366	.6187	.6127
29	.3886	.3695	.3633

TABLE 8

ACOL PROJECTIONS OF ENDSTRENGTH,
USING FY 77 EXPIRED OBLIGATIONS

LOS	FY 78	FY 79	FY 80
1	79,320	77,178	81,711
2	76,355	68,990	67,244
3	60,336	62,545	56,632
4	49,761	47,901	49,985
5	24,863	26,213	26,018
6	21,135	22,922	24,249
7	17,974	16,584	18,063
8	15,722	16,677	15,533
9	12,852	14,048	15,073
10	11,649	11,944	13,261
11	9,192	10,442	10,789
12	6,962	8,698	9,870
13	6,944	6,637	8,283
14	8,202	6,654	6,355
15	7,220	7,913	6,416
16	6,981	7,026	7,696
17	8,230	6,810	6,850
18	8,971	8,056	6,664
19	9,587	8,766	7,840
20	9,247	9,475	8,660
21	2,502	3,379	3,444
22	2,171	1,646	2,218
23	1,767	1,467	1,110
24	1,512	1,317	1,092
25	825	1,174	1,021
26	492	692	983
27	547	380	533
28	343	408	283
29	135	282	336
30	177	101	211
Total force	461,973	456,327	458,453
Career force	196,201	199,713	202,881

TABLE 9

ACOL PROJECTIONS OF ENDSTRENGTH,
USING PROPHET PROJECTED EXPIRED OBLIGATIONS

LOS	FY 78	FY 79	FY 80
1	71,259	72,531	81,710
2	76,326	62,007	63,215
3	65,404	67,832	55,300
4	53,543	56,006	57,402
5	26,774	28,345	28,427
6	19,651	22,206	24,197
7	17,651	15,346	17,394
8	15,417	16,114	14,338
9	12,467	13,392	14,067
10	11,714	11,730	12,712
11	9,254	10,597	10,618
12	6,995	8,793	10,076
13	6,966	6,670	8,381
14	8,209	6,670	6,377
15	7,209	7,891	6,401
16	6,965	6,991	7,642
17	8,210	6,769	6,782
18	8,960	8,016	6,607
19	9,577	8,733	7,809
20	9,246	9,458	8,621
21	2,497	3,346	3,402
22	2,057	1,517	2,038
23	1,708	1,307	965
24	1,456	1,208	929
25	802	1,093	905
26	484	658	897
27	541	368	497
28	326	376	256
29	132	263	303
30	172	94	184
Total force	461,973	456,327	458,453
Career force	195,441	197,951	200,826

TABLE 10

SUMMARY OF CAREER FORCE PROJECTIONS

	FY 78	% error	FY 79	% error	FY 80	% error
Historical	190,331	-	192,623	-	193,092	-
PROPHET	199,037	+4.6	203,673	+5.7	205,202	+6.3
ACOL, using FY 77 expired obligations	196,201	+3.0	199,713	+3.7	202,881	+5.1
ACOL, using PROPHET projected expired obligations	195,441	+2.7	197,951	+2.8	200,826	+4.0

REFINING THE ACOL PROJECTIONS

Although ACOL, as currently calibrated, overestimates the career force level, it appears to underestimate the responsiveness of the force level to pay changes. Relative military pay declined over the period FY 78-FY 80. The ACOL model did adjust reenlistment rates downward in response to this trend, but apparently did not do so to a sufficient extent. This seems to suggest recalibrating the pay coefficient in the logistic supply function to obtain greater conformity between the ACOL model's projections and historical data. However, there is independent evidence that the pay coefficient is correctly estimated.[1] Therefore, we have chosen not to pursue this option.

Instead, we have sought variables other than pay whose behavior over the period FY 78-FY 80 could improve the accuracy of the ACOL projections. One such variable is the civilian

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[1]Reference 4 provides the logit estimate of .000227 that we employ in our analysis. This estimate was obtained using FY [illegible] data. Alternatively, reference 7 provides probit estimates of pay coefficients for 28 rating groups, using FY 74 data. We calculated a weighted average of these probit estimates, using the number of reenlistment eligibles in the rating as the weight. This weighted average equals .000171. However, comparability requires that this probit estimate be re-scaled to reflect the 27 percent cumulative inflation that occurred between FY 74 and FY 77. Moreover, the probit estimate must be converted to a logit estimate, using the approximate conversion factor of $\pi/\sqrt{3}$ (reference 8, pages 5-6). Performing the two corrections, we arrive at an estimate of .000244, which is nearly identical to the logit estimate of .000227 employed in our analysis.

unemployment rate. Increased civilian unemployment represents a deterioration in alternatives to military service, hence we expect that an increase in the civilian unemployment rate will lead to an increase in the reenlistment rate.

We also investigated the effect of first-term reenlistment bonuses on subsequent second-term reenlistment rates. Warner argues (references 5,7) that first-term bonuses induce reenlistments on the part of individuals with lower tastes for military service than those who would have reenlisted in the absence of the bonuses. These marginal individuals are less likely to reenlist when they reach their second-term decision point.

To determine the magnitudes of these effects, we pooled data on second-termers in 90 ratings over the period FY 77-FY 80. We expressed the second-term reenlistment rate as a function of the contemporaneous second-term bonus multiple, the contemporaneous civilian unemployment rate among males aged 25-34, and the first-term bonus multiple that prevailed five years earlier. The lag of five years in the first-term bonus multiple was chosen to represent the average length of a first-term reenlistment. That is, first-term individuals who are induced to reenlist by bonuses will face their second reenlistment decision on average five years later, hence it will take about five years until first-term bonuses have their effect upon the second-term reenlistment rate.

We estimated that an increase of one percentage point in the civilian unemployment rate will lead to 2.7 additional reenlistments per 100 eligibles. We also estimated that a unit increase in the first-term bonus multiple will lead to 2.1 fewer second-term reenlistments per 100 eligibles five years later.[1]

REVISED ACOL PROJECTIONS

We revised the ACOL projections to incorporate the effects of civilian unemployment and lagged first-term bonuses. To accomplish this, we expanded the logistic supply function to include these two variables in addition to the relative military compensation variable. We employed the regression coefficients reported in the previous section. We also adjusted the intercept so that the inclusion of the two additional variables would leave the projections unchanged when evaluated at the base year values of all variables. Moreover, PROPHET projections of expired obligations were employed throughout.

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[1]Our estimated regression equation was:

$$\log (R/(1-R)) = -.262 - \underset{(-3.93)}{.0726}\ X_1 + \underset{(3.78)}{.109}\ X_2 - \underset{(-1.15)}{.0857}\ X_3,$$

where R is the reenlistment rate, X_1 is the second-term bonus multiple, X_2 is the civilian unemployment rate, and X_3 is the first-term bonus multiple lagged five years. This equation was estimated by generalized least squares, and t-statistics are reported in parentheses. The partial effects reported in the text are obtained after multiplying the regression coefficients by the factor R(1-R).

The values of the civilian unemployment rate and the lagged first-term bonus are displayed in table 11. The first-term bonus was computed as a weighted average of the bonus multiples in each rating, where the number of eligibles serves as the weight. No methodological issue arises from the inclusion of the lagged first-term bonus, since these values would have been available had the projections actually been made during FY 77. However, apart from the base year, the actual civilian unemployment rates would not have been available in FY 77. These values are only available through hindsight. Therefore, tables 12-13 report the ACOL projections that employ only the lagged first-term bonus, while tables 14-15 report those that employ both the lagged first-term bonus and the civilian unemployment rate.

Table 16 is a summary table. The first two rows of table 16 repeat the historical career force levels and the ACOL projections which ignore both lagged first-term bonuses and civilian unemployment. The third row presents the ACOL projections which include the lagged first-term bonuses. These projections are quite close to the historical values, lying within 2 percentage points in all three projection years.

The last row of table 16 presents the ACOL projections which include the civilian unemployment rate as well as the lagged first-term bonus. These projections are slightly higher than the historical value in FY 78 and slightly lower in FY 79-FY 80, but

TABLE 11

DATA FOR REVISED ACOL PROJECTIONS

	First-term bonus		Civilian unemployment rate
FY 72	3.17	FY 77	5.9
FY 73	3.26	FY 78	4.5
FY 74	2.71	FY 79	3.8
FY 75	2.56	FY 80	6.1

TABLE 12

ACOL REENLISTMENT RATES USING LAGGED BONUSES

LOS	FY 78	FY 79	FY 80
1	.4049	.3934	.3896
2	.1772	.1693	.1667
3	.2024	.1815	.1849
4	.2359	.2124	.2162
5	.4087	.3763	.3786
6	.3106	.2812	.2833
7	.5197	.4931	.5206
8	.5755	.5482	.5768
9	.6152	.5875	.6180
10	.7006	.6735	.6969
11	.7592	.7396	.7328
12	.8434	.8283	.8230
13	.8422	.8260	.8203
14	.8971	.8848	.8805
15	.9297	.9202	.9167
16	.9384	.9288	.9253
17	.9541	.9454	.9421
18	.9526	.9405	.9359
19	.9865	.9798	.9770
20	.3650	.3427	.3355
21	.4115	.3878	.3800
22	.4362	.4087	.3997
23	.5125	.4873	.4789
24	.5767	.5503	.5414
25	.7191	.6950	.6868
26	.7102	.6779	.6667
27	.5305	.5117	.5054
28	.6366	.6187	.6127
29	.3886	.3695	.3633

TABLE 13

ACOL FORCE LEVELS USING LAGGED BONUSES

LOS	FY 78	FY 79	FY 80
1	73,036	74,233	83,456
2	76,326	63,542	64,685
3	65,404	67,832	56,657
4	53,543	56,006	57,402
5	26,774	28,345	28,427
6	19,651	22,206	24,197
7	17,651	15,346	17,394
8	15,027	15,761	14,077
9	11,851	12,481	13,137
10	11,293	10,828	11,515
11	8,904	9,858	9,453
12	6,995	8,461	9,374
13	6,966	6,670	8,064
14	8,209	6,670	6,377
15	7,209	7,891	6,401
16	6,965	6,991	7,642
17	8,210	6,769	6,782
18	8,960	8,016	6,607
19	9,577	8,733	7,809
20	9,246	9,458	8,621
21	2,497	3,346	3,402
22	2,057	1,517	2,038
23	1,708	1,307	965
24	1,456	1,208	929
25	802	1,093	905
26	484	658	897
27	541	368	497
28	326	376	256
29	132	263	303
30	172	94	184
Total force	461,973	456,327	458,453
Career force	193,663	194,714	196,254

TABLE 14

ACOL REENLISTMENT RATES USING LAGGED BONUSES AND CIVILIAN UNEMPLOYMENT

LOS	FY 78	FY 79	FY 80
1	.3687	.3403	.3948
2	.1560	.1395	.1698
3	.1789	.1499	.1822
4	.2095	.1767	.2199
5	.3724	.3242	.3837
6	.2789	.2374	.2878
7	.3487	.3185	.4045
8	.4014	.3684	.4602
9	.4417	.4063	.5030
10	.5366	.4978	.5899
11	.7302	.6931	.7370
12	.8222	.7933	.8262
13	.8208	.7906	.8235
14	.8821	.8594	.8827
15	.9191	.9017	.9184
16	.9290	.9121	.9268
17	.9470	.9323	.9433
18	.9452	.9264	.9372
19	.9843	.9748	.9775
20	.3304	.2932	.3403
21	.3751	.3350	.3851
22	.3991	.3548	.4049
23	.4744	.4305	.4843
24	.5391	.4932	.5468
25	.6873	.6445	.6914
26	.6778	.6260	.6715
27	.4924	.4546	.5108
28	.6007	.5635	.6179
29	.3530	.3180	.3683

TABLE 15

ACOL FORCE LEVELS USING LAGGED
BONUSES AND CIVILIAN UNEMPLOYMENT

LOS	FY 78	FY 79	FY 80
1	75,198	77,542	82,781
2	76,323	65,406	67,544
3	65,397	67,818	58,304
4	53,364	55,753	57,422
5	26,043	27,007	28,457
6	19,467	21,259	23,110
7	17,424	14,949	16,703
8	14,925	15,415	13,732
9	11,684	12,147	12,884
10	11,176	10,528	11,246
11	8,800	9,585	9,207
12.	6,966	8,303	9,120
13	6,939	6,593	7,919
14	8,184	6,607	6,307
15	7,192	7,832	6,344
16	6,952	6,951	7,587
17	8,196	6,733	6,745
18	8,951	7,985	6,574
19	9,569	8,707	7,780
20	9,242	9,439	8,595
21	2,416	3,166	3,412
22	2,017	1,421	1,934
23	1,683	1,249	906
24	1,436	1,163	890
25	793	1,060	873
26	479	640	870
27	535	359	485
28	321	363	250
29	131	256	292
30	170	92	179
Total force	461,973	456,327	458,453
Career force	191,692	189,807	192,402

TABLE 16

SUMMARY OF REVISED ACOL PROJECTIONS

	FY 78	% error	FY 79	% error	FY 80	% error
Historical	190,331	-	192,623	-	193,092	-
ACOL	195,441	+2.7	197,951	+2.8	200,826	+4.0
ACOL with lagged bonuses	193,663	+1.8	194,714	+1.1	196,254	+1.6
ACOL, with lagged bonuses and civilian unemployment	191,692	+0.7	189,807	-1.5	192,402	-0.4

are always within 1.5 percentage points. They are the most accurate forecasts that we have been able to obtain. However, they do rely upon information which is only available through hindsight. Therefore, the strongest conclusion that we can reach is that the ACOL projections for careerists, corrected for lagged first-term bonuses, are accurate to within 2 percentage points. Most of the remaining forecast error can be attributed to variation in civilian unemployment over the projection period.

CONCLUSIONS

We compared the projections of the PROPHET and ACOL models to historical experience over the period FY 78 - FY 80. The PROPHET model tracks the distribution of the force by years of remaining obligated service, but does not allow reenlistment rates to vary in response to changes in compensation. Conversely, the ACOL model does allow reenlistment rates to vary in response to changes in compensation, but does not track the distribution of the force by years of remaining obligated service. We found that the ACOL projections are more accurate than the PROPHET projections. Evidently, adjusting reenlistment rates in response to pay changes is more important than tracking the force by years of remaining obligated service.

We also ran projections of the two models sequentially, so that the PROPHET model projections of expired obligations were

used as an input to the ACOL model. The results of this procedure were superior to those obtained using either model separately. However, we still had a forecast error of 3 to 4 percentage points. To reduce this error, we made allowance for the effect of first-term reenlistment bonuses on subsequent second-term reenlistment rates. This enabled us to reduce the forecast error to about 2 percentage points.

We were able to further reduce the forecast error to almost zero by using information on civilian unemployment during the projection period, FY 78-FY 80. However, this information is only available through hindsight, and would not have been available had the projections actually been made during the base year, FY 77. Therefore, the strongest conclusion possible is that the ACOL projections are accurate to within 2 percentage points, with most of the remaining forecast error being attributable to variation in civilian unemployment over the projection period.

REFERENCES

1. Center for Naval Analyses, Memorandum (CNA)77-1310, "Projections of Navy Enlisted Endstrength with the PROPHET Model: FY 1977-83," by Peter B. McWhite, Unclassified, 30 Aug 1977

2. Center for Naval Analyses, Memorandum (CNA)78-0045, "Models for Enlisted Manpower and Personnel Planning," by Robert F. Lockman, Cdr. Edward M. Barrow, and Robert H. Simmons, Unclassified, 3 Apr 1978

3. Center for Naval Analyses, Research Contribution 346, "The PROPHET System for Projection of Inventories in Ratings and Other Subpopulations," by Marc D. Joseph, Unclassified, May 1978

4. Center for Naval Analyses, Research Contribution 376, "Alternative Military Retirement Systems: Their Effects On Enlisted Retention," by John T. Warner, Unclassified, Sep 1979

5. Center for Naval Analyses, Research Contribution 436, "Military Compensation and Retention: An Analysis of Alternative Models and a Simulation of a New Retention Model," by John T. Warner, forthcoming

6. "Employment and Earnings," U.S. Department of Labor, Bureau of Labor Statistics

7. Center for Naval Analyses, Memorandum (CNA)79-1878, "An Empirical Analysis of Pay and Navy Enlisted Retention in the AVF: Preliminary Results," by John T. Warner and Bruce Simon, 21 Dec 1979

8. Norman L. Johnson and Samuel Katz, "Distributions in Statistics: Continuous Univariate Distributions - Vol. 2," Boston, 1970

CNA PROFESSIONAL PAPERS - 1978 TO PRESENT*

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**The Graduate School of Management, University of Rochester

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Dismukes, Bradford and Petersen, Charles C., "Maritime Factors Affecting Iberian Security," (Factores Maritimos que Afectan la Seguridad Iberica) 14 pp., Oct 1980, AD A092 733

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**Arizona State University

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*Northwestern University, Evanston, IL

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Kenny, Lawrence W., Lee, Lung-Fei, Maddala, G. S., and Trost R. P., "Returns to College Education: An Investigation of Self-Selection Bias Based on the Project Talent Data," 15 pp., Jan 1982. (Published in International Economic Review, Vol. 20, No. 3, October 1979), AD A112 480

PP 335
Lee, Lung-Fei, G.S. Maddala, and R. P. Trost, "Asymptotic Covariance Matrices of Two-Stage Probit and Two-Stage Tobit Methods for Simultaneous Equations Models with Selectivity," 13 pp., Jan 1982. (Published in Econometrica, Vol. 48, No. 2 March, 1980), AD A112 483

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